Glial Cells- Non Neuron cells, Structural Support

Neuroglial cells or glial cells provide supporting functions to the nervous system. Early research viewed glial cells as the "glue" of the nervous system

Glial cells are found in the central nervous system (CNS) and peripheral nervous system (PNS). The important CNS glial cells are astrocytes, microglia, oligodendrocytes, radial glial cells, and ependymal cells. Schwann cells, enteric glial cells, and satellite glial cells are part of the PNS.

Neuron- Communication

A neuron is a nerve cell that is the basic building block of the nervous system. Neurons are similar to other cells in the human body in a number of ways, but there is one key difference between neurons and other cells. Neurons are specialized to transmit information throughout the body.

Types of neurons

Sensory Neurons- carry information from sense to brain

Motor neurons- carry information from brain to muscles

Interneurons- for communicating information between different neurons

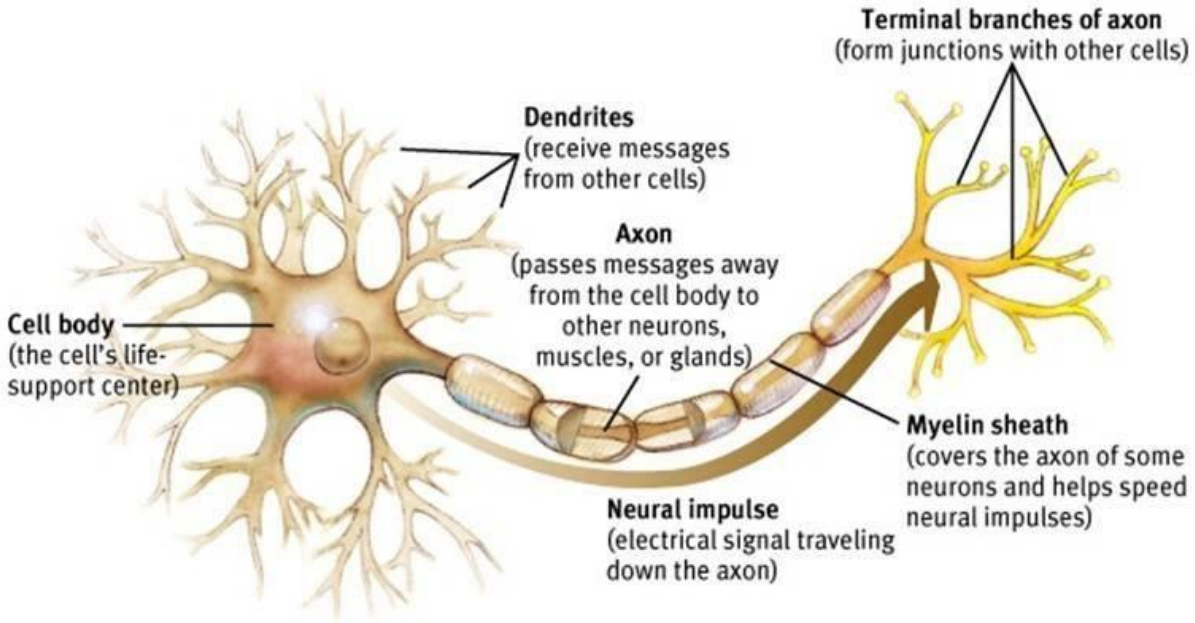
Structure of neuron

1. The dendrites- receives
2. The cell body-
3. The axon- transmit away

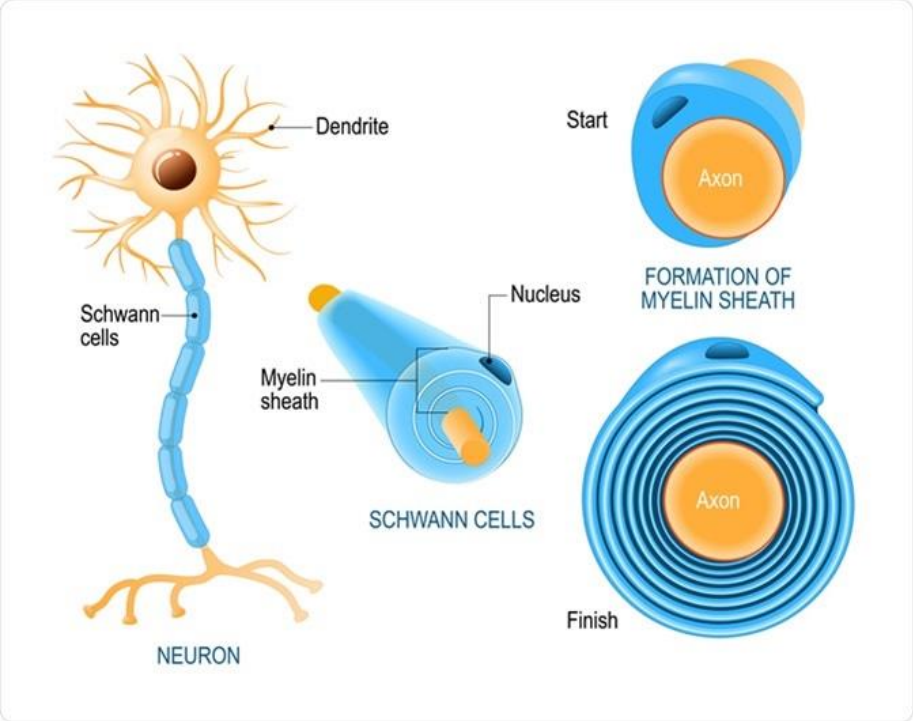
Terminal Button- secrete neurotransmitter

Synapse-junction where information is transmitted.

SHOUT
SHARE
IT
SECURITY



Schwann cells are **a type of glial cells of the peripheral nervous system** that help form the myelin sheath around the nerve fibres. Myelin sheath of the neuron. A Schwann cell envelops and rotates around the axon forming myelin sheath, now axon is myelinated.



Communication Within Neuron

Resting Potential

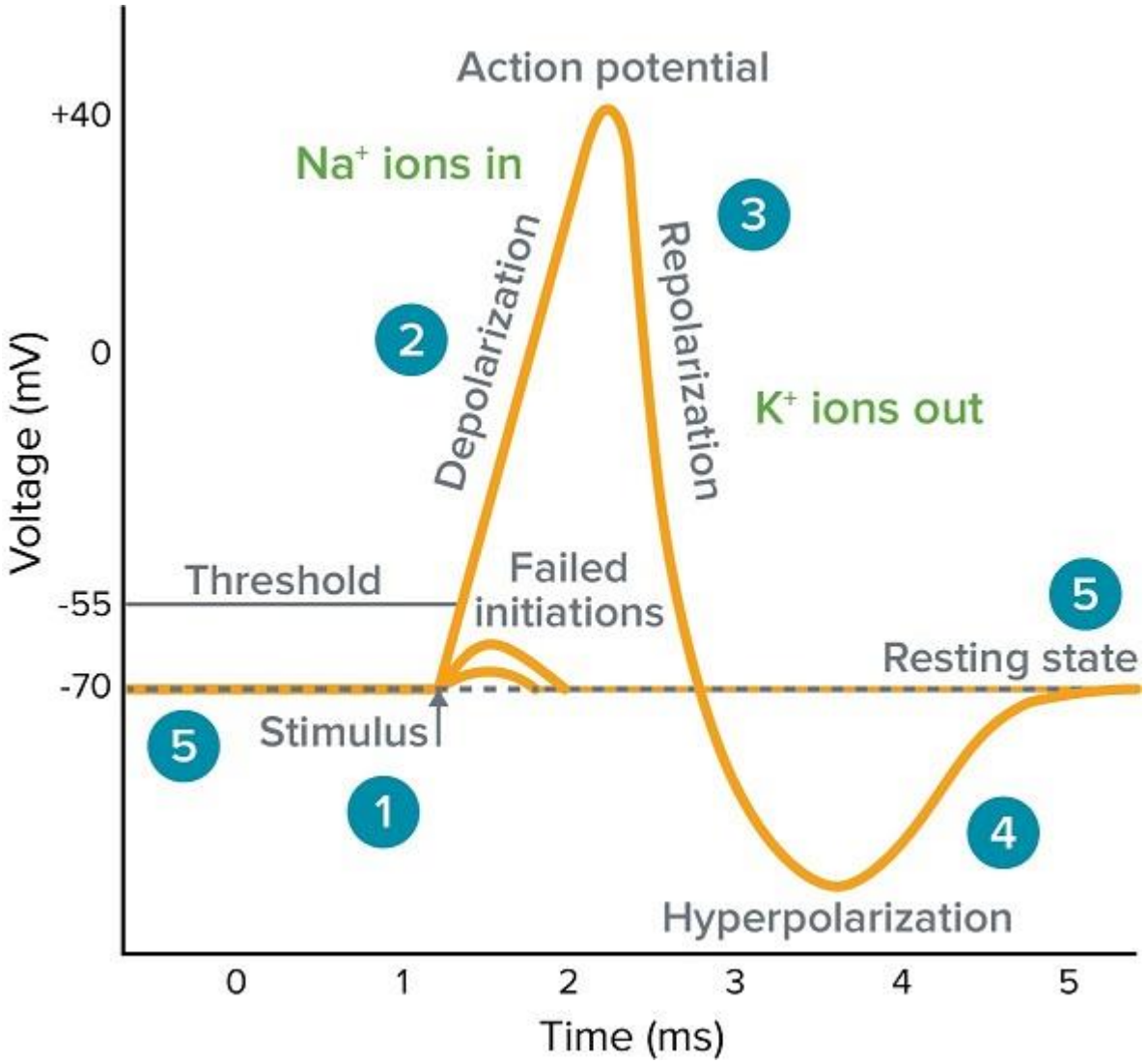
- ✓ -70 millivolts across the cell membrane. The insight of the cell has a slight negative charge relative to the outside.
- ✓ Stimulation either directly (heat, pressure, or light)or by chemical messages from other neuron produces Graded Potential (GP)
- ✓ GP is a basic type of signal within neurons that results from external physical stimulation of the dendrites or cell body
- ✓ In contrast to the ALL-OR-NONE nature of action potential, graded potential vary in proportion to the size of the stimulus that produces them.
  Example- A loud sound or bright light produces graded potential of greater magnitude than a softer sound or dim light..

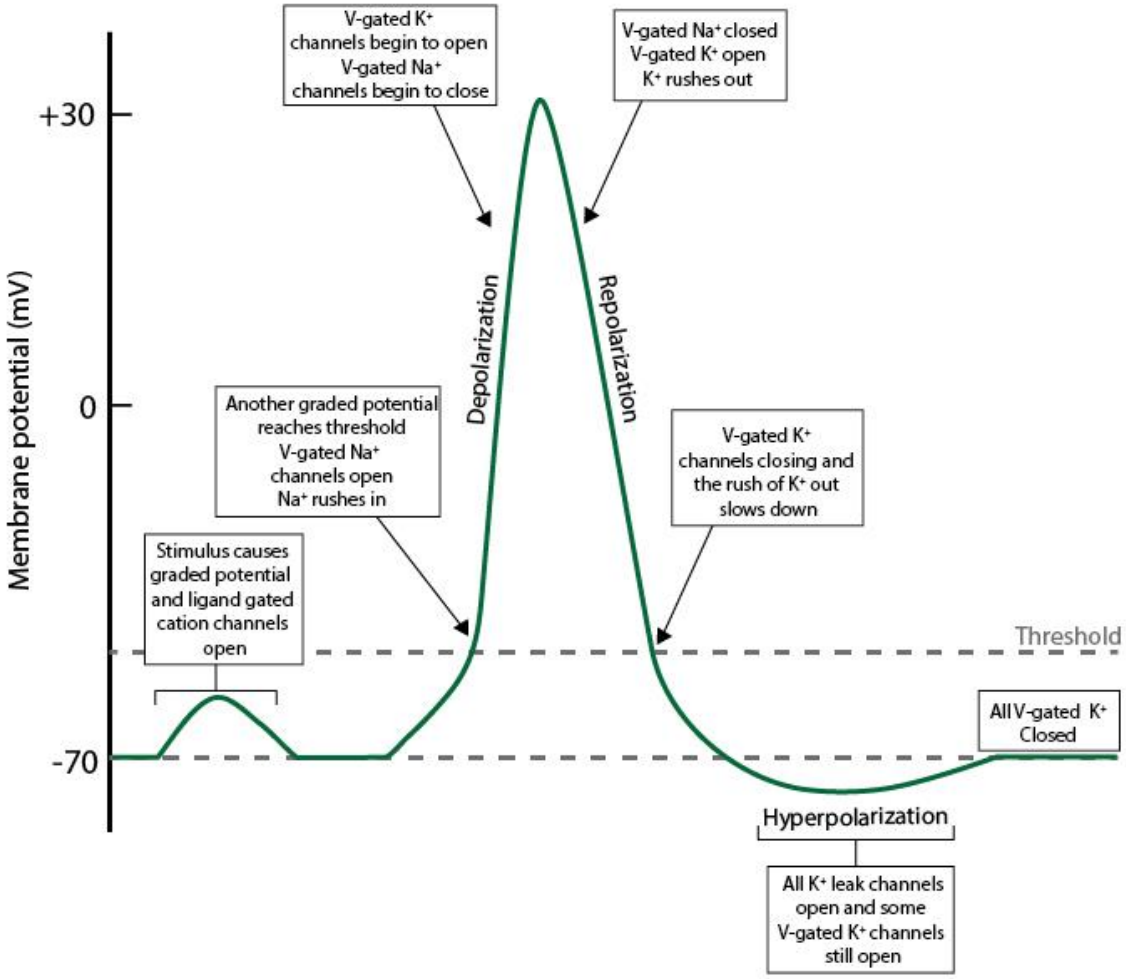
During Action Potential some ions (+vely charged) are briefly allowed to enter the cell membrane more rapidly than before.

Action Potential (+40) is the basic signal within our nervous system
In its wake, the action potential leaves the Na+ channels inactivated and K+ channels activated. These transitory changes make it harder for the axon to produce subsequent action potential during this interval, which is called the refractory potential

All or None (-55mv) Law

The all-or-none law is a principle that states that **the strength of a response of a nerve cell or muscle fiber is not dependent upon the strength of the stimulus**. Essentially, there will either be a full response or there will be no response at all for an individual neuron or muscle fiber


Action potential
+40
Na+ ions in
3
Depolarization
Repolarization
2
0
K+ ions out
Voltage (mV)
Threshold
Failed initiations
5
-55
Resting state
-70
5
Stimulus
1
4
Hyperpolarization
0
1
2
3
4
5
Time (ms)


V-gated K+ channels begin to open
V-gated Na+ channels begin to close
V-gated Na+ closed
V-gated K+ open
K+ rushes out
+30
0
-70
Membrane potential (mV)
Depolarization
Repolarization
Another graded potential reaches threshold
V-gated Na+ channels open
Na+ rushes in
V-gated K+ channels closing and the rush of K+ out slows down
Stimulus causes graded potential and ligand gated cation channels open
Threshold
All V-gated K+ Closed
Hyperpolarization
All K+ leak channels open and some V-gated K+ channels still open

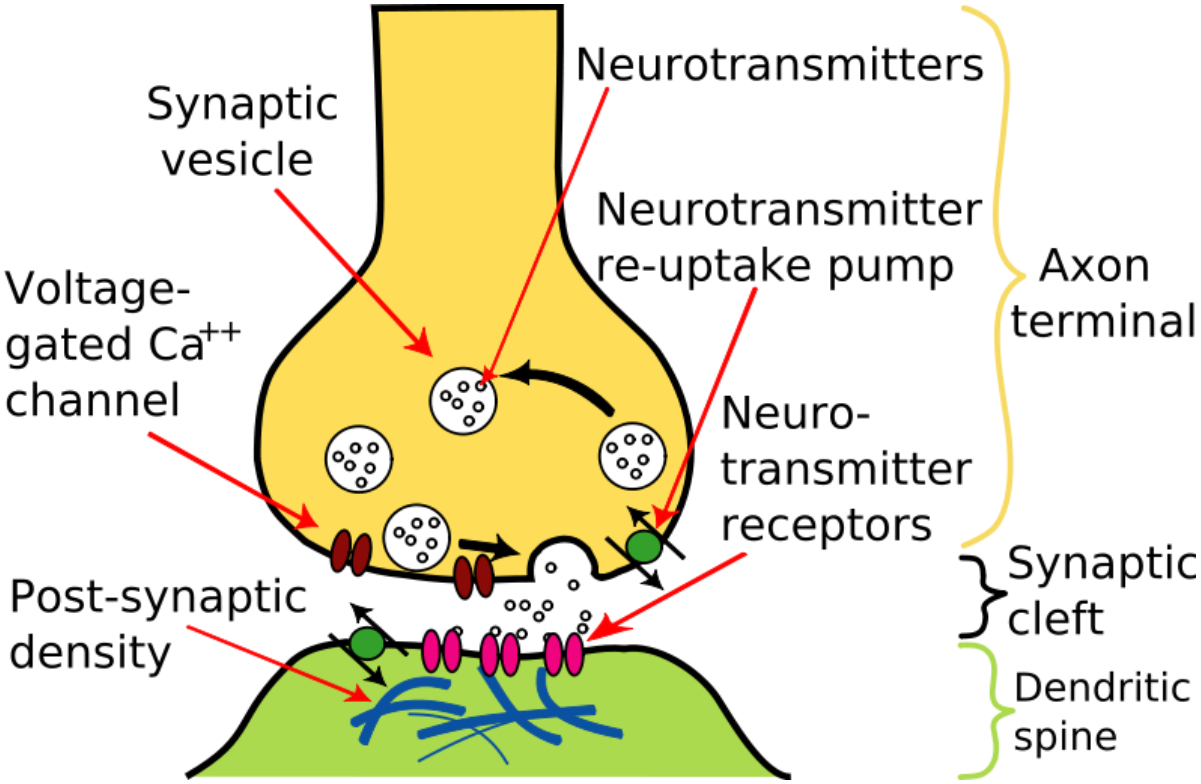
Communication between Neurons

Synapse-a structure that permits a neuron (or nerve cell) to pass an electrical or chemical signal to another neuron

Synaptic cleft- A synaptic cleft is a **space that separates two neurons**

1. action potential generated near the soma. Travels very fast down the axon. ...
2. vesicles fuse with the pre-synaptic membrane. As they fuse, they release their contents (neurotransmitters).
3. Neurotransmitter's flow into the synaptic cleft. ...

4. Now you have a neurotransmitter free in the synaptic cleft.
5. Neurotransmitters bind to receptors.
6. Ions flow through the open receptor.



Receptors and neurotransmitters act like a lock-and-key system. Just as it takes the right key to open a specific lock, a neurotransmitter (the key) will only bind to a specific receptor (the lock). If the neurotransmitter is able to work on the receptor site, it triggers changes in the receiving cell

- ✓ Agonist- Agonists are **substances that bind to synaptic receptors and increase the effect of the neurotransmitter**.
- ✓ Antagonist- Antagonists also bind to synaptic receptors but they decrease the effect of the neurotransmitter.

Neurotransmitter	Function
Dopamine	Acts as the "feel good" reward mechanism of the brain; enhances sensations
Acetylcholine	Stimulates muscles, especially the gastrointestinal system
Norepinephrine	Increases the sympathetic nervous system (heart rate, blood pressure, respiratory system)
Serotonin	Affects emotion, mood, and perception
GABA (gamma aminobutyric acid)	Affects motor control, vision, and anxiety
Glutamate	Affects learning, memory, and cognition
Endorphins	Causes pain reduction and pleasure

Nervous system

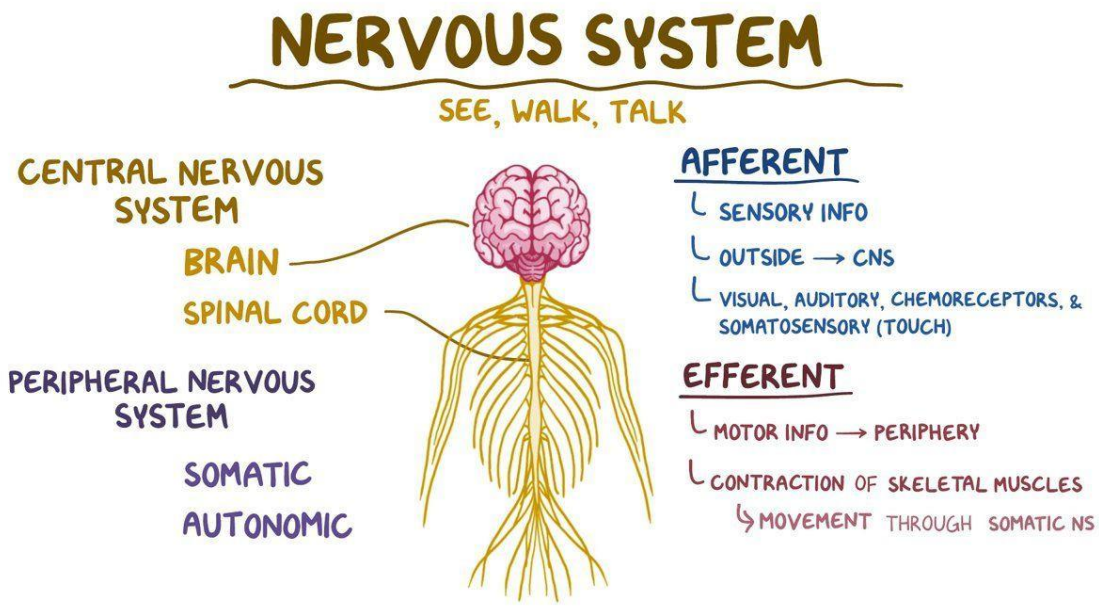
1. Central Nervous System

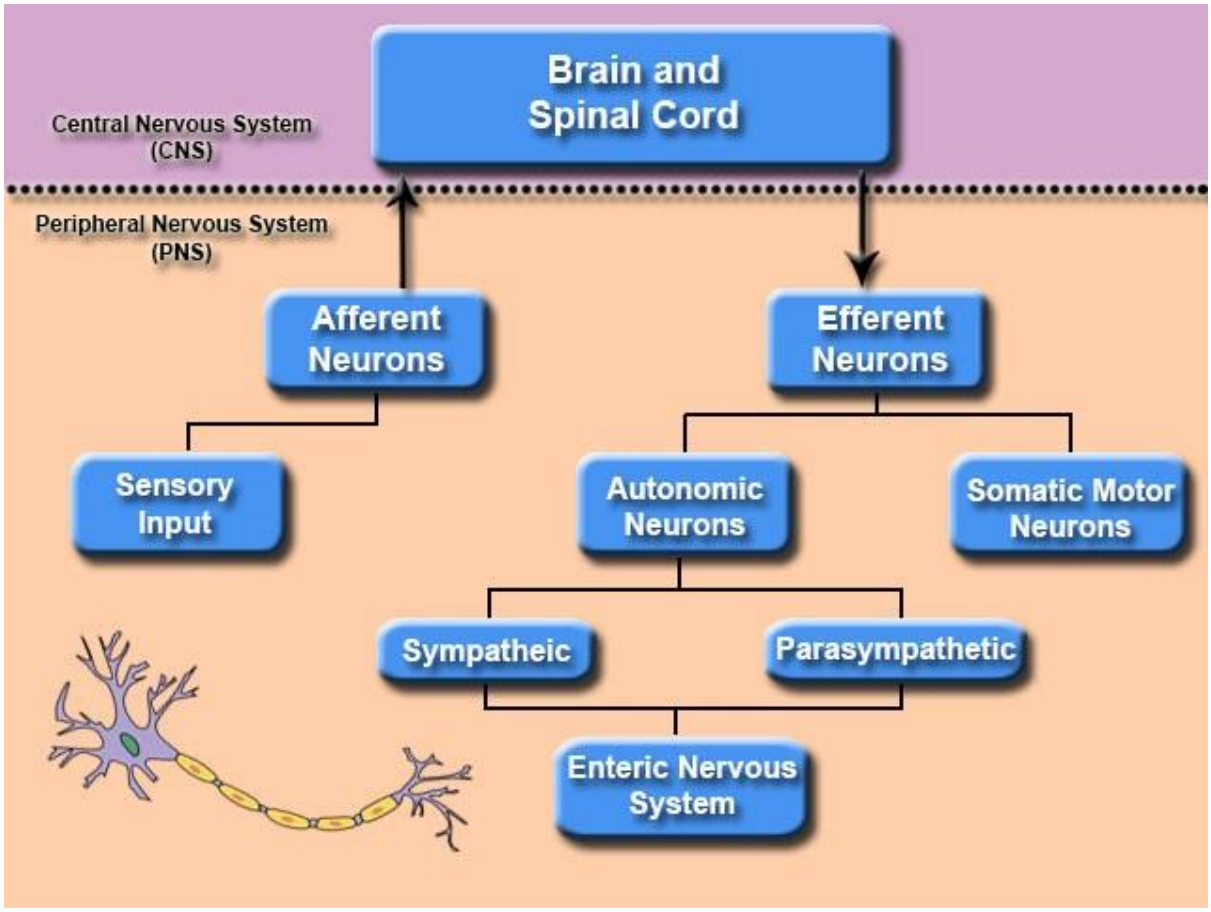
2. Peripheral Nervous System- i) Somatic and ii). Autonomic

i)Somatic-Voluntary Muscles and sensory receptors

ii) Autonomic-Controls autonomic, involuntary Function-

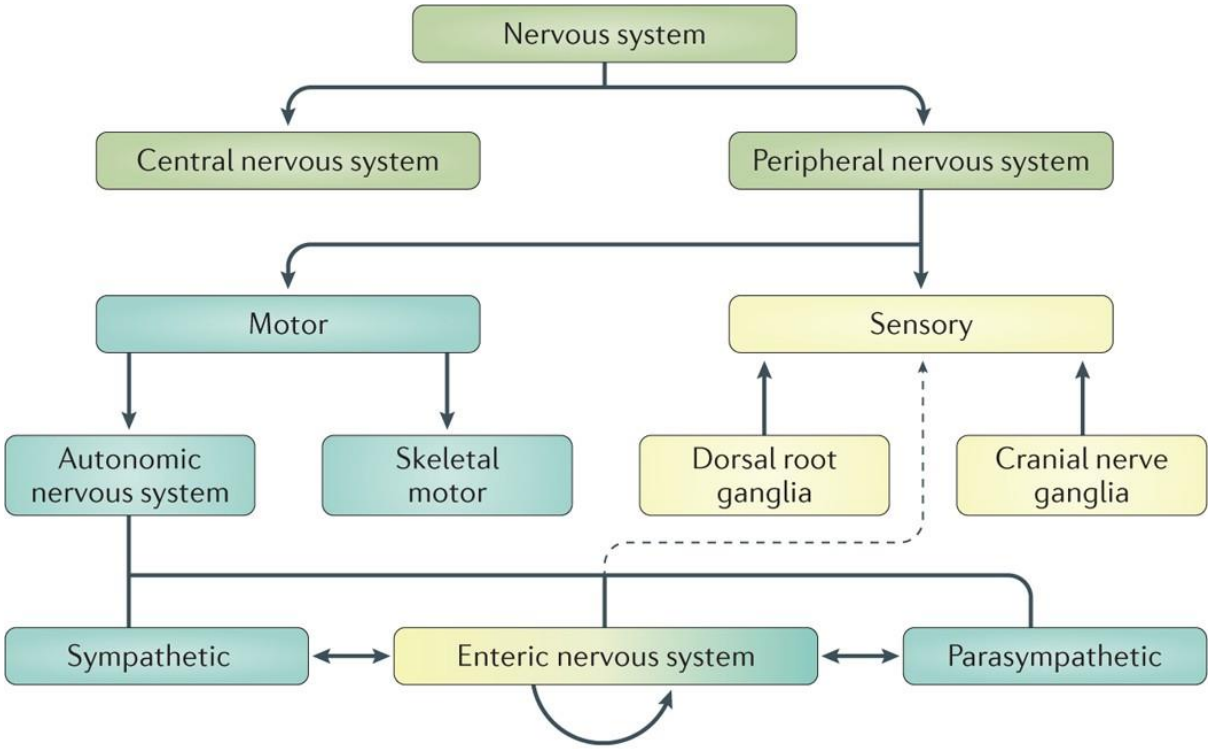
a) Sympathetic- Go (Fight or flight response)
b) Parasympathetic- Stop





Enteric Nervous system -muscular and secretory activity of the gastrointestinal tract.

The enteric nervous system (ENS) is a web of sensory neurons, motor neurons, and interneurons embedded in the wall of the gastrointesinal system, stretching from the lower third of the esophagus right through to the rectum. The neurons of the ENS are arranged in two layers, the submucosal and myenteric plexuses of the gut wall. It has been estimated that the ENS actually contains more neurons than the whole of the spinal cord



- ✓ **Dorsal Root Ganglia-** The dorsal root ganglion contains **the cell bodies of sensory neurons that bring information from the periphery to the spinal cord**

- ✓ **Cranial Nerve ganglia-**cranial nerve ganglia convey gustatory information from the mouth, pharynx, and larynx to the brain. Neurons of each of these ganglia arise from two discrete embryonic regions: the epibranchial placodes and a subset of the cranial neural crest

Brain- Three parts

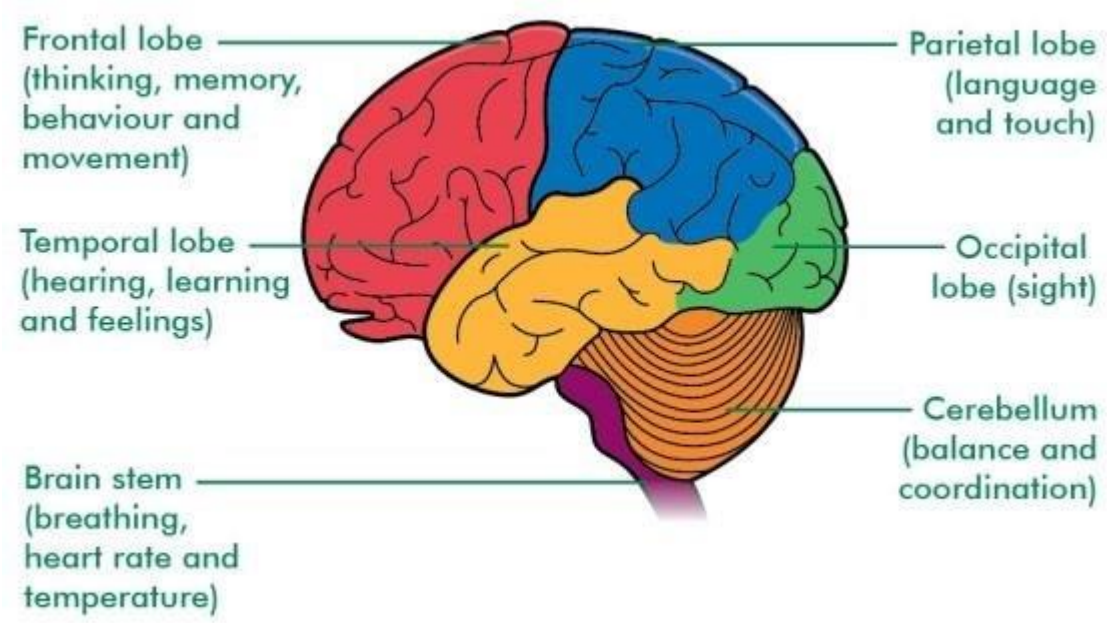
Forebrain

It is the anterior part of the brain. The forebrain parts include:

- Cerebrum
- Hypothalamus
- Thalamus
- Limbic System

Forebrain Function: Controls the reproductive functions, body temperature, emotions, hunger and sleep. Fact: The largest among the forebrain parts is the cerebrum. It is also the largest part of all vertebrate brains

The Cerebrum: Also known as the cerebral cortex, the cerebrum is the largest part of the human brain, and it is associated with higher brain function such as thought and action. Its wrinkled surface increases the surface area, and is a six-layered structure found in mammals, called the neocortex. It is divided into four sections, called "lobes". They are; **the frontal lobe, the parietal lobe, the occipital lobe and the temporal lobe**


Frontal lobe (thinking, memory, behaviour and movement)
Parietal lobe (language and touch)
Temporal lobe (hearing, learning and feelings)
Occipital lobe (sight)
Cerebellum (balance and coordination)
Brain stem (breathing, heart rate and temperature)

Hypothalamus

The primary role of the hypothalamus is to regulate various functions of the pituitary gland and endocrine activity, as well as somatic functions e.g., Body temperature, sleep, appetite.

Thalamus

The primary role of the thalamus is to relay sensory information from other parts of the brain to the cerebral cortex

Limbic System The limbic system is often referred to as our "emotional brain", or 'childish brain'. It is found buried within the cerebrum. It helps in maintain internal homeostasis by regulating body temperature, blood pressure and blood sugar level. The limbic system comprises the Hippocampus and Amygdala

Hippocampus

The primary role of the hippocampus is memory forming, organizing and storing information. It is particularly important in forming new memories, and connecting emotions and senses, such as smell and sound, to memories.

Amygdala The primary role of the amygdala is to be a critical processor for the senses. Connected to the hippocampus, it plays a role in emotionally laden memories and contains a huge number of opiate receptor sites that are implicated in rage, fear and sexual feelings.

Mid Brain

Mid Brain Smallest and central part of the brain

The midbrain consists of:

- Tectum
- Tegmentum
- Cerebral aqueduct
- Cerebral peduncles
- Several nuclei and fasciculi.

The midbrain is located below the cerebral cortex, and above the hindbrain placing it near the centre of the brain. The primary role of the midbrain is to act as a sort of relay station for our visual and auditory systems. Portions of the midbrain called the red nucleus and the

substantia nigra are involved in the control of body movement, and contain a large number of dopamine-producing neurons.

Hind Brain: The lower part of the brain

The hindbrain is composed of:

- Cerebellum
- Medulla
- Pons Cerebellum
-

The cerebellum, or "little brain", is similar to the cerebrum with its two hemispheres and highly folded surface. It is associated with regulation and coordination of movement, posture, balance and cardiac, respiratory and vasomotor centres

Medulla

The primary role of the medulla is regulating our involuntary life sustaining functions such as breathing, swallowing and heart rate. As part of the brain stem, it also helps transfer neural messages to and from the brain and spinal cord. It is located at the junction of the spinal cord and brain.

Pons

The pons is the primary structure of the brain stem present between the midbrain and medulla oblongata. It serves as a relay signal between the lower cerebellum, spinal cord, the midbrain, cerebrum and other higher parts of the brain. The main functions of the pons include:

➢ Controlling sleep cycles.

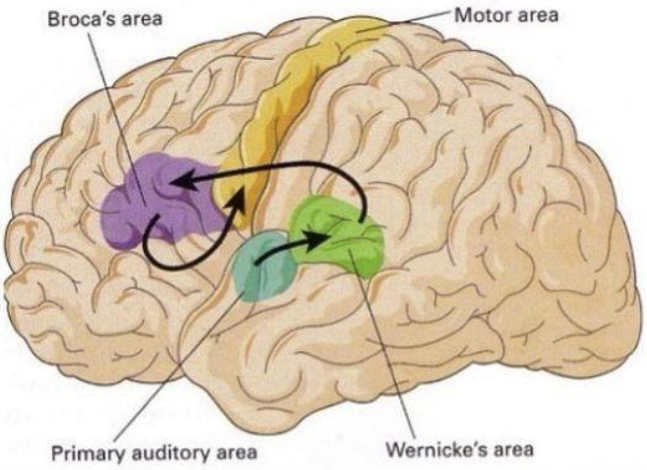
➢ Regulating the magnitude and frequency of the respiration.

➢ Transfers information between the cerebellum and motor cortex.

➢ Pons is also involved in sensations, such as the sense of taste, hearing and balance

A deep furrow divides the cerebrum into two halves, known as the left and right hemispheres. And, while the two hemispheres look almost symmetrical, each side seems to function differently. The right hemisphere is considered our creative side, and the left hemisphere is considered our logical side. A bundle of axons, called the corpus callosum, connects the two hemispheres. In general, the left hemisphere of the brain is responsible for language and speech and is called the "dominant" hemisphere. The right hemisphere plays a large part in interpreting visual information and spatial processing.

➢ Broca's area: lies in the left frontal lobe. If this area is damaged, one may have difficulty moving the tongue or facial muscles to produce the sounds of speech. The person can still read and understand spoken language but has difficulty in speaking and writing ➢ Wernicke's area: lies in the left temporal lobe. Damage to this area causes Wernicke's aphasia. The individual may speak in long sentences that have no meaning, add unnecessary words, and even create new words.



Broca's Area (Nonfluent)
Motor
Frontal Lobe
Speech is slow & broken

B = Broken words
Bad Mother Fucker
Broca Motor Frontal

Wernicke's Area (Fluent)
Sensory
Temporal Lobe
Speech is normal and excessive but makes little sense

W = Wacky Words or Word Salad

Biological Bases of Motivation

1. Hunger (Hypothalamus)

Lateral Hypothalamus- Excite Hunger

Ventrolateral Hypothalamus- Inhibit Hunger

2. Thirst- (Anterior hypothalamus)- Osmoreceptor

Osmoreceptors generate nerve impulses in case of cell dehydration

Cellular dehydration thirst- Loss of water

Loss of Blood volume- triggers thirst for water and salt via renin angiotensin system

Adipsia - Adipsia is a **disease characterized by the absence of thirst even in the presence of body** water depletion or salt excess. It is a rare condition that typically presents as hypernatremia dehydration. The cause is usually a hypothalamic lesion, which can be congenital or acquired

Sleep

Sex